The problem of declining amphibian populations in the Commonwealth of Independent States and adjacent territories

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Published evidence of amphibian declines within the territory of C.I.S. and adjacent territories (formerly U.S.S.R.) are reviewed. Populations of more than half of all the species are subject to decline. Most of the recorded declines and extinctions are local; the main causes are anthropogenic factors, especially deforestation, destruction of water bodies, pollution and urbanization. Few species are expanding under anthropogenic influences. The history of the expansion of *Rana ridibunda* is briefly discussed.

Introduction

The study on amphibian ecology in the former U.S.S.R. has been conducted for several decades. The recent dismemberment of the U.S.S.R. has led to the formation of the Commonwealth of Independent States (C.I.S.) and few republics have not joined this.

Here I summarize the published and some unpublished data on the phenomenon of declining amphibian populations within this territory. Analysing such information, the researcher faces several problems. How to distinguish between stable declines and temporary fluctuations in numbers? What are the extents of declines? Which conclusions on the declines were made on the basis of subjective estimations, and which on the basis of exact quantified data? Unfortunately, not all the papers reviewed contained the answers to these questions. However, a comparative analysis permits some conclusions on the population trends in different regions. In the analysis I have used puplications concerned with almost all the republics of the former U.S.S.R. Papers with data only on population number and lacking data on dynamics were not used.

Generally, the population changes may be analysed on two time-scales: long-term and short-term. The first includes, conventionally, changes in geological and historical times: covering millions to hundreds of years. The second includes changes from a century to one year or less, and concerns fluctuations in population numbers.

Long-term changes

One can say with certainty that global changes of climate have influenced amphibian numbers and distributions. A large proportion of contemporary Eurasian amphibian species already existed in the late Pliocene. Glaciations and regressions of glaciers, expansions and reductions of forests and steppes during the last 600-700 thousand years had a great impact on the distribution and dynamics of amphibians (Borkin, 1984). For example, Quaternary remains of a toad related to *Bufo raddei* (now representative of the Mongolian fauna) were found in European Russia. Quaternary bones resembling those of *Salamandrella keyserlingii* have been found c. 800 km SW from the species' contemporary range (Ratnikov, 1989). In addition, many bones of Quaternary tailless amphibians attributed to extinct species have been found in Russia. Thus, we can ascertain the extinctions of amphibian species within the territory of former U.S S.R. during the last few hundred thousand years.

It is evident that more recent changes have also occurred. For example, changes have probably taken place during the last thousand years in the territory of Tatarstan (Garanin, 1989). During the cold periods the northern taiga species *S. keyserlingii* occurred there and, in warm periods, *Hyla arborea*. Forest species, *Triturus cristatus*, *Bufo bufo*, and *Rana temporaria*, receded northwards due to forest destruction. In the Vth-XIIIth centuries and later, the increase of agriculture may have caused the spreading northwards of the southern species *Bombina bombina* and *Pelobates fuscus*. Thus, long-term changes in climate and landscape may have influenced species in different ways, according to their specific ecological requirements.

Short-term changes

Population declines

Taxa

From 13 species of Caudata inhabiting the former U.S.S.R., declines are documented in 11 (Table I). The remaining two, *Triturus dobrogicus* and *Hynobius turkestanicus* are simply unexplored. From 27 anuran species, declines are documented in 15 (Table I). This probably reflects the better state of anuran populations compared to caudates, rather than the scarcity of information on some anuran species. Most reports concern the declines of widespread and numerous species, such as common toad, brown frogs, etc. The declines of endemic and relic species (*O. fischeri*, *R. sibiricus*, *M. caucasica*, *T. vittatus*, *T. montandoni*, *T. alpestris*, *T. karelini*, *P. caucasicus*, *P syriacus*) are probably local. Nevertheless, such declines may have severe consequences due to low total number and narrow ranges.

Time and regions

Most data on declines are from the period 1970-1990. Basically, this reflects increasing interest in nature conservation at this time. At the same time, there was an increase in anthropogenic influences on amphibian populations. Earlier declines in the 1920s and 1940s were connected mainly with the destruction of habitats due to urbanization, industrialization, establishment of collective farms, and with the Second World War (BANNIKOV & ISAKOV, 1967; BESKROVNY & BURMENSKAYA, 1970).

The most numerous declines have been registered in the European region (Table I). This reflects not only the better exploration of this region, but probably the real situation. Reports from Western Siberia and the Far East are much less numerous, though these regions have been studied to a reasonable extent.

Natural factors

Natural factors (see legend of Table I) are rarely reported as causes of amphibian declines. In these instances the main factor is probably natural community succession leading to eutrophication and overgrowth of the breeding ponds. These factors are indicated for four amphibian species, and may have led to extinctions of isolated populations especially in urban areas.

Anthropogenic factors

Anthropogenic factors probably play the main role in the recent declines (see Table I). *Destruction of forests and other arboreal vegetation* appears to be most widespread. This factor is indicated in 23 % of papers containing information on the causes of declines. This leads not only to destruction of terrestrial habitats, but also to the drying of breeding ponds and brooks. Deforestation was indicated as the cause of declines of 40 % of species studied. This is most harmful for the forest species such as newts and common toads. *Pond drainage* has been reported as a second main factor of amphibian declines (20 % of papers; indicated for 44 % of species). *Intensive use of artificial fertilizers and pesticides* was reported as a factor of declines in 14 % of reports and for 40 % of species. This influences amphibians mainly by spoiling of water, frequenly caused by *water pollution by cattle and industrial wastes* (each reported in 11 % of papers). Nevertheless, the second kind of pollution appears to be more harmful than the first: this was reported for 40 and 16 % of species studied, respectively. Other anthropogenic factors (see footnote to Table I) have been reported relatively rarely (in 3-6 % of papers) and concerned, as a rule, only 4 to 13 % of species studied.

Only *urbanization*, as a complex factor, being not frequently indicated, concerns 36 % of species. This has caused sharp declines of amphibians In the large cities, such as Moscow, Nizhny Novgorod and Ekaterinburg, amphibian numbers decreased from the periphery of city to the centre (BANNIKOV & ISAKOV, 1967; LEBEDINSKY, 1981; VERSHININ, 1987; KUZMIN, 1989; USHAKOV & BELOBORODOVA, 1989). *B. viridis*, *R. temporaria*, *R. arvalis* and *R. ridibunda* are better adapted to life in urban areas than other amphibians, but under excessive urbanization they also have disappeared. The process of extinction

Table I - Amphibian declines in the territory of former U S S R

Years —: unknown

Causes of declines - A anthropogenic factors (1 destruction of forests and other arboreal vegetation, 2 destruction of hiding places, 3 streambank damage by cattle; 4 intensive cattle pasture, 5 intensive use of artificial fertilizers and pesticides in agriculture, 6 use of pesticides, 7 use of fertilizers, 8 removal of the rice fields, 9 earthwork, 10 pond drainage, 11 pond destruction, 12 pond clearing and building of embankments, 13 water pollution by cattle; 14 industrial pollution of water; 15 pollution of water by domestic wastes, 16 transportation of logs by heavy traffic, 17 overflooding, 18. pollution and drying of streams, 19. trailing of the cut trees along the streams, 20 river bank clearing and building of embankments, 21 introduction of the fish *Percottus glehni*, 22 introduction of *Rana ridibunda*, 23 urbanization, 24. collecting for commercial aims, 25 collecting for educational aims, 26 collecting for scientific aims, 27 fishing, 28 intensive recreation), N natural factors (1. mudding of ponds, 2 partial drying of ponds, 3 increase of water eutrophication, 4 overgrowth and shallowing of ponds, 5 probable increase of temperature and decrease of humidity), — unknown

Sources of information. - 1-63 numbers of references in "Literature cited", SK personal unpublished data, RK personal communication of R. A. Kubykin

Species	Regions	Years	Causes of declines	Sources of information
Salamandrella keyserlingii	Siberia Upper Angara River	—	A2, A10	42
Onychodactylus fischeri	Far East	—	A1	46
Ranodon sibiricus	Kazakhstan Upper Cherkassai River	1970s	A26	34
	Kazakhstan Dzhungarian Alatau		A3, A13, A27	14
Salamandra salamandra	Ukrainian Carpathians	1960-1970s	A1, A24, A25	43, 52
Mertensiella caucasica	Georgia	—	A18	26
	Georgia	1980s	A19	SK
Triturus vulgaris	Moscow	1920-1980s	A11, A12, A14, A23	SK, 10, 36
	Moscow Province: Glubokoe Lake	1973-1990	A21	38
	Volga-Kama region	—	A1	19
	Lower Volga	1973-1988	A5	33
	Ukrainian Carpathians	—	A6, A10, A14, A15	54
	Azerbaijan	—	A8, A10	1
Triturus vittatus	North Caucasus	1960-1980s	A7, A10, A13, N1, N2, N3	57
	Georgia	—	A10, A13, A14	26
Triturus montandoni	Ukrainian Carpathians	10-15 years	A24, A25	43, 54
	Skobelevskie Beskidy, Lvov	1948-1984	A16	52, 53
Triturus alpestris	Ukrainian Carpathians and Skobelevskie Beskidy, Lvov	10-15 years	A24, A25	43, 54
Triturus karelini	Chechnya	—	A1	3
	Azerbaijan	—	A10	1
Triturus cristatus	Moscow	1980s	A10, A11, A14, A23, N3, N4	SK, 10, 36
	Moscow Province Glubokoe Lake	1973-1990	A21	38
	Volga-Kama District	—	A1	19
	Delta of Don	1920-1945	A1	12
	Ukrainian Carpathians		A6, A10, A14, A15	53

Table I. - Continuation.

Species	Regions	Years	Causes of declines	Sources of information
Bombina bombina	Moscow	1920-1980s	A10, A11, A23	10, 36
	Volga-Kama region	—	A1	19
	Severny Donets	1980-1986	A13	21
	Lower Volga	1973-1988	A5	33
	Ukrainian Polesje	—	A10	63
Pelodytes caucasicus	North Caucasus	—	A1, A9, A18	22
	Chechnya	—	A18	3
	Georgia	—	A18	26
Pelobates fuscus	Moscow	1922-1966	A11, A23	10, 36
	Moscow Province	—	A28	23
	Lower Volga	1973-1988	A5	33
	Severny Donets	1980-1986	A4	21
	Steppe on Dnepr	—	A14	39
Pelobates syriacus	Georgia	—	A10, A13, A14	26
	Armenia	—	—	16
Bufo bufo	Moscow	1922-1966	A11, A23	10, 36
	Voronezh	1950-1970	A1	19
	Volga-Kama region	—	A1	19
	Novosibirsk	1939-1969	—	54
	Altai Mountains	1980s	A22	62
	Baikal region	1960-1970	A1, A4	49
	Steppe on Dnepr and Dnestr Rivers	—	A1, A5	30, 51
Bufo viridis	Moscow	1922-1980	A10, A11, A14, A23	SK, 10, 36, 40
	Severny Donets	1980-1986	A4	21
	Lower Volga	1973-1988	A5	33
	Tbilisi	—	A2, A6	28
Hyla arborea	Steppe on Dnepr	—	A5	30
	Ukrainian Carpathians	—	A1	43
Hyla japonica	Siberia Zea River	—	A17	25
Rana temporaria	Moscow	1922-1980	A11, A14, A23, N4	SK, 10, 36
	Moscow Province	—	A6, A7	40
Rana arvalis	Moscow	1922-1980s	A11, A14, A23, N4	SK, 10, 36
	Moscow Province	—	A6, A7	40
	Serveny Donets	1980-1986	A4	21
	Volga-Kama region	1953-1963	N5	18
	Lower Volga	1973-1988	A5	33
	Novosibirsk	1939-1969	—	54
	Altai Mountains	1980s	A22	62
Rana macrocnemis	Turkmenistan. Kopetdag Mountains	—	A1	6
Rana asiatica	Kazakhstan. Kapchagai District	1960s-1970s	A17	RK
Rana lessonae / esculenta	Moscow	1920-1980	A11, A14, A23, N3, N4	SK, 10, 36
	Ukrainian Polesje	—	A10	63
Rana ridibunda	Moscow	1920-1980	A11, A14, A20	SK, 10, 36
	Lower Volga	1973-1988	A5	33
	Ukrainian Polesje	—	A10	63
	Kyzgyzstan. Chu River	—	A25, A26	58

starts from the fragmentation of a population by residential districts and main roads. Then, as a result of isolation, susceptibility to anthropogenic and natural influences (inbreeding, droughts, frosts, pollution, etc.) is increased. After the last breeding centres have been destroyed, the animals may breed for a some time in shallow puddles. Finally, the population becomes extinct after the last adults die. Population declines may occur even if some ponds remain, if they have been cleared and concreted. The latter make the shores unsuitable for most amphibians.

The *influence of reservoirs* is complex. Commonly these did not lead to sharp changes in amphibian species composition Some species (mainly terrestrial) may decrease in number, but some time later (up to 10 years) they can recover (Kaletskaya, 1953; Ilyashenko, 1989; Smirnova & Egorov, 1985, Derkach et al, 1989; Ushakov & Pisarenko, 1989). In the Carpathian Mountains, the construction of reservoirs permitted some lowland species to enter the mountains, such as *T. vulgaris*, *T. cristatus*, *R. ridibunda*, *R. lessonae/esculenta* (Polushina, 1977)

Extent

The extent of amphibian declines varies among the species and is determined by different causes. Local extinction, as a rule, is caused by a complex of anthropogenic factors. These situations were indicated for all the species listed in Table I, with a few exceptions: *S. keyserlingii*, *T. karelini*, *H japonica*, and *R. macrocnemis*. Local extinctions are most frequent in European region, reflecting the greater extent to which it has been studied. Deforestation is the most frequent key factor in local extinctions (Polushina, 1977; Garanin, 1983). However, in a historical perspective, this may have more "global" consequences for species (change of geographical ranges, etc.). Urbanization leads to local declines. However, the rate of these declines is species-specific. In general, forest species tended to decline and become extinct more rapidly than open-area species.

Some factors are reported to cause declines but not extinction For example, introduction of the fish *Percottus glehni* into some ponds in the Moscow Province led to local declines of *T vulgaris* and *T. cristatus* to less than 10 % of their previous abundance (Manteifel et al , 1991) Intensive cattle pasture led to marked declines in *B. bombina* and *R. arvalis* numbers in different habitats of Severny Donets River basin (European Russia) (Gogoleva, 1987).

Some factors have had complex negative influences. For example, felling of trees and their trailing along the moutain streams led to almost total extinction of some Georgian micropopulations of *M. caucasica* (personal observations). On the other hand, on the Carpathian Mountains timber transportation by heavy traffic leads to the formation of deep ruts in the roads, creating suitable conditions for newt breeding. The newts are attracted by newly established water bodies and breed there. This led to the killing of *T. montandoni* and *T. alpestris* (mainly eggs and larvae) by traffic and drying As a result, the population declined markedly (Taraszczuk, 1985). Although overall amphibian mortality on the roads may be high, its influence on population declines is unclear (Ganeev et al, 1985; Ryzhevich, 1989).

FLUCTUATIONS IN NUMBERS

Changes in population sizes have been documented in several regions of the former U.S.S.R. Fluctuations caused by anthropogenic factors were briefly noted above. Fluctuations of the numbers of *R. temporaria* and *R. arvalis* are caused by periodic droughts and frosts (SERGEEV & VETSHEVA, 1942; BANNIKOV, 1948; KALETSKAYA, 1953). After droughts marked reductions in the numbers of brown frogs occur, caused by breeding ponds drying up. Afterwards frog numbers recover due to successful breeding in renewed ponds. Fall in population size is also caused by high mortality in hibernacula during frosty winters with little snow. Different species show different reactions to both factors. *R. temporaria* is less tolerant of drought than the more southerly *R. arvalis*. The latter, however, is less tolerant of frosts due to its exclusively terrestrial hibernation. Green frogs living in permanent waters express higher tolerance to both factors. Monitoring of amphibian populations in Volga-Kama region has shown wide annual fluctuations of both specific and total amphibian densities (sometimes by 20-30 times) against the background of the total decline (fig. 1). In other cases, the fluctuations are not accompanied by this trend (fig. 2).

POPULATION INCREASE AND DISPERSAL

Extensions of geographical ranges and population increases may occur not only in geological time, but also during the short term. For example, in Belorussia the increase of *P. fuscus*, *B. calamita* and *H. arborea* probably took place in the XXth century (SAPOZHENKOV, 1961). Its causes are still unknown. In Moscow Province the increase in number and the dispersal of southern species (*B. bombina*, *P. fuscus*, *B. viridis*, *R. arvalis*) occurred in the 1920-1940s, whereas the northern species either reduced their numbers (*B. bufo*), or remained almost unchanged (*R. temporaria*) (BANNIKOV,1955). As in *B. bufo*, *B. viridis* and *R. arvalis*, this tendency was observed at least up to the 1980s (personal observations). This is probably related to the general warming of the regional climate.

However, population increases and dispersals are basically related to anthropogenic factors. In Moscow Province ploughing up the water meadows led to a local increase of *P. fuscus* (GORBUNOV, 1989). Tree-felling and country-road building in forests resulted in the formation of small artificial pond systems and promoted the increase and local dispersal of *S. keyserlingii*, *P. fuscus*, *B. bufo*, *B. viridis*, *R. temporaria* and *R. arvalis* (POLUSHINA, 1977; PIKULIK, 1985; KUTENKOV, 1990; ISHCHENKO, personal communication). These were documented in Karelia, Ural, Belorussia and Carpathians. The creation of artificial water bodies (fishponds, channels, sedimentation reservoirs, etc.) has promoted population increases in *S. keyserlingii*, *T. vulgaris*, *T. vittatus*, *B. bombina*, *P. fuscus*, *B. bufo*, *H. arborea*, *R. arvalis*, *R. temporaria*, *R. ridibunda*, and *R. lessonae/esculenta* (TOPORKOVA, 1977; KUBANTSEV & ZHUKOVA, 1981, KIREEV, 1983; TUNIYEV et al., 1986; GOGOLEVA, 1987; TARASZCZUK, 1987; KUTENKOV, 1990; personal observations). These events were observed in Central and Southern Russia, Kalmykia, Karelia, Middle Ural, Northern Caucasus, forest and steppe zones of the Ukraine.

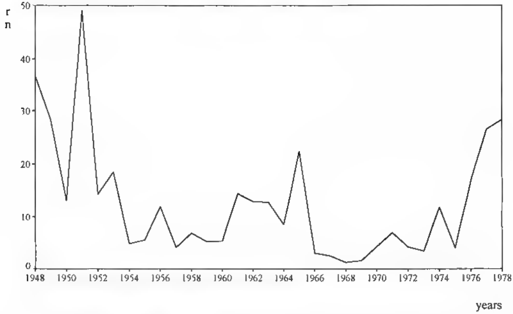

Fig.1. — Annual fluctuations in amphibian numbers in a plot of Volga-Kama region, Russia (from GARANIN, 1983)

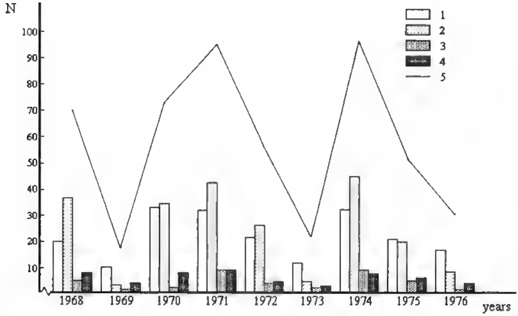

Fig.2 Annual fluctuations of different amphibian species on lakeshores of the Marii El, Russia (ASTRADAMOV & ALYSHEVA, 1979) 1: *Rana arvalis*; 2: *Rana esculenta/lessonae*; 3 *Rana ridibunda*; 4: *Bombina bombina*; 5: total number.

There are some examples of deliberate introductions of Anura by man. Breeding *B. viridis* were found in 1984 in Novosibirsk City — at 650 km from the range margin of this species (ZOLOTARENKO, 1985). *R. nigromaculata* tadpoles were imported to Turkmenistan from China together with herbivorous fry fishes about 30 years ago. The frog was successfully acclimatized in the Kara-Kum Channel (ATAEV & ATAEVA, 1981).

The most marked expansions are shown by *R. ridibunda*. Probably, between 1903 and 1939 this species naturally penetrated the Lake Balkhash basin (Kazakhstan) from the River Chu valley (Kyrgyzstan) (KORELOV, 1953). Between 1964 and 1970 the species extended eastwards: into the surroundings of Uch-Aral Village (Alakul Hollow, Kazakhstan) (GRACHEV, 1971). Subsequent dispersal of the species was conditioned by anthropogenic factors: in the European steppe and desert regions, by land-reclamation; in Siberia, by thermal pollution of the environment (pouring out of warm waters into the permanent reservoirs). In the 1960s, the frog was introduced with fry fishes to Issyk-Kul Lake from River Chu valley, Kyrgyzstan, and started to displace local *Rana asiatica*. In 1969, tadpoles were imported with fry fishes from Krasnodar (Southern Russia) into the city of Verkhny Tagil (Ural); since 1976, the population has expanded into neighbouring rivers (TOPORKOVA, 1977, 1978). Introductions to other Uralian cities (Ekaterinburg in 1977 and Chelyabinsk in 1981) led to new populations being established (VERSHININ, 1990). In 1970, the species was first recorded in the city of Gorno-Altaisk (Altai Mountains, Eastern Siberia), where it was introduced from the Osh Province (Kyrgyzstan) with fishes. Since that time, a stable population of *R. ridibunda* has been established, which has displaced local *B. bufo* and *R. arvalis* at some sites (YAKOVLEV, 1990). At the same time *R. ridibunda* was introduced into ponds in Yakutsk City (BELIMOV & SEDALISHCHEV, 1980). Introductions in Kazakhstan (cities of Karaganda, Pavlodar and Ust-Kamenogorsk) were probably related to the release of frogs from local universities and institutes (PRUS & SMOLYANINOVA, 1989).

PERSPECTIVES

Quantitative data on declining amphibian populations in the former U.S.S.R. are not numerous. Nevertheless, existing records show declines to be widespread. Anthropogenic factors play the main role in this. Inexplicable declines, or extensive short-term declines under natural factors, have not been registered here. The increase and dispersal of several species under anthropogenic influences have taken place against a general background of impoverishment of regional amphibian assemblages. "Perestroika" and the dismemberment of the U.S.S.R. have led to economic and political chaos. The latter may result in both the retardation of environmental destruction due to the closing of factories, and in non-controlled destruction of nature in other sites due to violation of laws. The latter may already be occurring, e.g. in an unprecedented trade in amphibians, including protected species.

In 1992, a C.I.S. Regional Group was established within the Declining Amphibian Populations Task Force of I.U.C.N. This Group consists of amphibian biologists working in 10 Sub-Regional Groups. We look forward to consolidating our studies on amphibian declines within the territory of the former U.S.S.R.

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LITERATURE CITED

(all original references are in Russian)

(1) ALEKPEROV, A. M. & JAFAROVA, S. K., 1981 – On the status, distribution and number of amphibian and reptile species included into *Red data book* of Azerbaijan. *In*: *Vozdeistvie antropogennykh factorov na faunu i ecologiyu zhivotnykh v Azerbaijane*, Baku 28-34.

(2) ANDRUSHKO, A. M., 1973 – Amphibians and reptiles give a signal of disaster. *In*: *Problems of herpetology*, Leningrad, Nauka: 10-13

(3) ANISIMOV, P S, 1989. *Rare and extincting vertebrates of Checheno-Ingush A.S.S R* Grozny, Chechen.-Ingush. Publ. House: 1-157.

(4) ASTRADAMOV, V I. & ALYSHEVA, G. I., 1979. Number dynamics and biomass of amphibians of Simkinsky reserve. *In*. *Ecologo-faunisticheskie issledovaniyua v Nechernozemnoi Zone R.S F S R*, **2**, Saransk: 77-82.

(5) ATAEV, C. & ATAEVA, A. A., 1981. – On the joint existence of *Rana ridibunda* and *R. nigromaculata* in Turkmenistan. *Izvestiyua Akademii Nauk T.S.S.R*, (Seriya biologicheskikh Nauk), **3** 71-73

(6) ATAEVA, A. A., 1981. – *Zemnovodnye Turkmenistana*. Ph. D. Thesis, Kiev: 1-24.

(7) BAKHAREV, V A., 1987. – Contemporary status of the herpetofauna of Byelovezhskaya Pushcha. *In*: *Problems of herpetology*, Leningrad, Nauka: 22-23.

(8) BANNIKOV, A. G., 1948. On the fluctuation of number of tailless amphibians. *C. r. Acad. Sci. U.R.S.S.*, **61** (1): 131-134.

(9) ----- 1955. – On the changes in the distribution of amphibians in Moscow surroundings *Uchonye zapiski Moskovskogo Gosudarstvennogo Pedagogicheskogo Instituta, Kafedra Zoologii*, **3**: 219-222.

(10) BANNIKOV, A. G. & ISAKOV, Y. A, 1967. – On the amphibians in Moscow city. *In Zhivotnoe naselenie Moskvy i Podmoskovyua*, Moscow: 92-96.

(11) BELIMOV, G T. & SEDALISHCHEV, V T, 1980 – *Rana ridibunda* in the ponds of Yakutsk. *Vestnik Zoologii*, **3** 74-75.

(12) BESKROVNY, M. A. & BURMENSKAYA, N. M., 1970. – On the periodic changes of ranges of some amphibians due to economic human activity. *In Materialy 4th nauchnoi konferentsii zoologov pedagogicheskikh institutov*, Gorky: 302-304.

(13) BORKIN, L Y, 1984. - European-Far Eastern disjunctions of geographic ranges in amphibians new analysis of the problem. *In*: *Ecology and faunistics of amphibians and reptiles of U.S S.R. and adjacent countries*, Leningrad: 55-88.

(14) BRUSHKO, Z. K & NARBAEVA, S P., 1988 Reproduction of *Ranodon sibiricus* in the river Borokhudzir valley (south-western Kazakhstan). *Ekologiya*, **2**: 45-49.

(15) DERKACH, O. M, TARASZCZUK, S V. & MIROSHNICHENKO, V I, 1989. Forecast of the changes of herpetofauna of the valley of Yuzhny Bug river in the region of building of South-Ukrainian energetic complex. *In*: *Problems of herpetology*, Kiev, Naukova Dumka: 78-79.

(16) EGIAZARYAN, E M, 1981 – New data on the distribution of *Pelobates syriacus* in Armenia. *In Problems of herpetology*, Leningrad, Nauka: 52.

(17) GANEEV, I. G., GARANIN, V. I & KNYAZEV, V. P, 1985 – Influence of the autoroads on fauna *In*: *Vzaimodeistvie mezhdu komponentami ekologicheskikh sistem*, Kazan 139-144.

(18) GARANIN, V I, 1964 – Changes in the number of amphibians of the east European part of U S S R. *In*: *Sovremennye problemy izucheniya dinamiki chislennosti populatsii zhivotnykh*, Moscow: 26-27.

(19) ----- 1983. — *Zemnovodnye i presmykayuszczıesya Volzhsko-Kamskogo kraya*. Moscow, Nauka 1-174.
(20) ----- 1989 — Dynamics of herpetofauna of Prikazanje *In*: *Problems of herpetology*, Kiev, Naukova Dumka: 53-54.
(21) GOGOLEVA, N. P., 1987. — Influence of the anthropogenic factors on the distribution and number of amphibians in the conditions of South of forested steppe zone (Byelgorod province). *In*: *Vliyanie antropogennoi transformatsii landshafta na naselenie nazemnykh pozvonochnykh zhivotnykh*, **2**, Moscow: 182-184.
(22) GOLUBEV, N. S., 1984. — Number of the *Pelodytes caucasicus* and some factors determining this. *In*: *Fauna i ekologiya amfibii i reptilii*, Krasnodar, Kubansky Univ. Publ.: 15-23.
(23) GORBUNOV, E. P., 1989 — On the ecology of *Pelobates fuscus* in the Moscow district *In* *Zemnovodnye i presmykayushchiesya Moskowskoi oblasti*, Moscow, Nauka 133-141.
(24) GRACHEV, V. A., 1971 — New data on the spread of *Rana ridibunda* in Kazakhstan. *Bulleten Moscowskogo Obshchestva Ispytatelei Prirody, Otdel biologicheskii*, **76** (4): 123-124.
(25) ILYASHENKO, V. Y., 1984 — Influence of the Zea storage lake on the herpetofauna. *In*. *Vid i ego produktivnost v areale*, **5**, *Voprosy Gerpetologii*, Sverdlovsk. 20-21
(26) JANASHVILI, A G. & ZHORDANIYA, R. G., 1981. Rare and scarce amphibians and reptiles of Georgia and their conservation *Problems of herpetology*, Leningrad, Nauka: 49.
(27) KALETSKAYA, M L., 1953. Fauna of amphibians and reptiles of the Darvinsky reserve and its changes due to Rybinskoe storage lake *In*: *Rybinskoe vodokhranilishche*, **1**, Moscow. 171-186.
(28) KHODZHEVANISHVILI, I. A. & BAKRADZE, M. A , 1990. - Batracho- and herpetofauna of the Tbilisi botanical garden. *In*: *Introduktsiya rastenii i zelenoe stroitelstvo*, **19**. 225-229.
(29) KIREEV, V. A, 1983. *Zhivotnii mir Kalmykii Zemnovodnye i Presmykayushchiesya*. Elista, Kalmykian Book Publ.: 1-112
(30) KONSTANTINOVA, N. F , 1981. - On the rare and extincting species of amphibians and reptiles in the conditions of intense anthropogenic factors in the steppe Pridneprovie *In*: *Problems of herpetology*, Leningrad, Nauka: 70
(31) KORELOV, M. N., 1953. - Penetration of *Rana ridibunda* into the Balkhash basin. *Bulleten Moskowskogo Obshchestva Ispytatelei Prirody, Otdel biologicheskii*, **58** (4): 33-34.
(32) KUBANTSEV, B. S & ZHUKOVA, T. I., 1981. — *Rana ridibunda* as an object of anthropogenic influences. *In*: *Problems of herpetology*, Leningrad, Nauka 74-75
(33) KUBANTSEV, V S & KOLYAKIN, N N , 1988. — Composition and distribution of the amphibians in northern districts of the Nizhnee Polozhie *In* *Zhivotnyi mir Predkavkazya i sopredelnykh territorii*, Stavropol: 54-59
(34) KUBYKIN, R. A., 1986. — On the ecology of *Ranodon sibiricus*. *In*: *Redkie zhivotnye Kazakhstana*, Alma-Ata: 187-191.
(35) KUTENKOV, A. P., 1990 — Reproduction of tailless amphibians of Southern Karelia and its connection with some forms of economic activity. *In* *Anthropogennoe vozdeistvie na prirodu zapovednikov*, Moscow: 38-50.
(36) KUZMIN, S. L., 1989. — Amphibians and reptiles of North-West of Moscow *In* *Zemnovodnye i presmykayushchiesya Moskowskoi oblasti*, Moscow, Nauka Publ.: 48-60.
(37) LEBEDINSKY, A. A., 1981. — Peculiarities of the distribution of amphibians on the urbanized territory. *In*: *Nazemnye i vodnye ekosystemy*, **4**, Gorky: 49-56.
(38) MANTEIFEL, Y. B., BASTAKOV, V A., KISELYOVA, E I & MARGOLIS, S E , 1991. — Amphibia of nature reservation "Lake Glubokoe": a short essay on population state, studies on neuroethology and sensory ecology. *Bulleten Moskowskogo Obshchestva Ispytatelei Prirody, Otdel biologichekii*, **96** (2): 103-110.
(39) MISYURA, A N & NOSKOVA, S. V , 1987. — Dynamics of some ecological-biochemical indices of *Pelobates fuscus* in the technogenous ecosystems *In* *Vliyanie antropogennoi transformatsii landshafta na naselenie nazemnykh pozvonochnykh zhivotnykh*, Moscow. 184-185.
(40) MURKINA, N V , 1989 — On the status of amphibian fauna of Moscow and Moscow province in connection with the anthropogenic pressure *In* *Zemnovodnye i presmykayushchiesya Moskowskoi oblasti*, Moscow, Nauka: 81-84.
(41) PIKULIK, M M , 1985. Comparative characterisation of the status of herpetofauna of Berezinskii and Pripyatskii reserves. *In*: *Zapovedniki Byelorussii*, **10**: 133-140.

(42) Pleshanova, G. I., 1985. – Amphibians and reptiles in the anthropogenic landscapes of Upper Angara. *In*: *Problems of herpetology*, Leningrad, Nauka: 168-169.
(43) Polushina, M. A., 1977. – Changes in the number and distribution of amphibians and reptiles of Ukrainian Carpathians in 1950-1975. *In*: *Problems of herpetology*, Leningrad, Nauka Publ.: 177-179.
(44) Prus, L. N. & Smolyaninova, M. K., 1989. – On the biology of *Rana ridibunda* of the city of Karaganda and surroundings. *In*: *Vliyanie genotipa i komplexa ekologicheskikh faktorov na zhiznedeyatelnost organizmov*, Karaganda: 70-76.
(45) Ratnikov, V. Y., 1989. – Some notes on the records of herpetofauna in Quaternary deposites of Eastern Europe. *In*: *Problems of herpetology*, Kiev, Naukova Dumka: 208-209.
(46) Ryzhevich, K. K., 1989. – Death of amphibians and reptiles on the roads. *In*: *Molodezh i sovremennaya nauka*, Kishinev: 57-58.
(47) Sapozhenkov, Y. F., 1961. – On the widening of the ranges of some species of Belorussian amphibians. *In*: *Fauna i ekologiya pozvonochnykh Belorussii*, Minsk: 195-196.
(48) Sergeev, A. M. & Vetsheva, A. G., 1942. – On the problem of influence of drought on the dynamics of number of *Rana temporaria* in the European part of U.S.S.R. *Zoologichesky Zhurnal*, **21** (5): 202-206.
(49) Shvetsov, Y. G., 1984. – The state of the number of amphibians and reptiles in the Lake Baikal basin. *In*: *Vid i ego produktivnost v areale*, Part IV, *Voprosy gerpetologii*, Sverdlovsk: 48-49.
(50) Smirnova, M. I. & Egorov, Y. E., 1985. – The role of amphibians in the terrestrial ecosystems of Kuibyshevskoe storage lake basin. *In*: *Experimentalnoe izuchenie iskusstvennykh i estestvennykh ekosistem*, **2**, Kazan: 3-14.
(51) Taraszczuk, S. V., 1987. – *Herpetofauna of North-Eastern shore of the Black Sea and its changes under the anthropogenic factors*. Ph. D. Thesis, Kiev, Inst. Zool. Acad. Sci. U.S.S.R.: 1-25.
(52) Taraszczuk, V. I., 1985. – The dependence of the number of some amphibian species of Carpathians on the technology of tree transportation. *In*: *Problems of herpetology*, Leningrad, Nauka: 204-205.
(53) Tatarinov, K. A., 1977. – Extincting species of amphibians and reptiles of Carpathians and the measures for their conservation. *In*: *Problems of herpetology*, Leningrad, Nauka Publ.: 200-201.
(54) Telegin, V. I., 1971. – Fauna of the forest-park and influence of anthropogenic factor on its formation. *Izvestiya Sibirskogo Otdeleniya Akademii Nauk S.S.S.R.*, (Seriya biologicheskikh Nauk), **1** (5): 58-66.
(55) Toporkova, L. Y., 1977. – Influence of the human activity on the amphibian distribution. *In*: *Problems of herpetology*, Leningrad, Nauka: 204-205.
(56) ----- 1978. – New element in the herpetofauna of mountain-taiga zone of the Middle Ural. *In*: *Fauna i ekologiya zhivotnykh U.A.S.S.R. i prilezhashchikh raionov*, **2**, Izhevsk: 63-68.
(57) Tuniyev, B. S., Bakradze, M. A. & Beregovaya, S. Y., 1986. – On distribution and ecology of the banded newt, *Triturus vittatus* (Jenyns, 1835). *In*: *Herpetological investigations in the Caucasus*, Leningrad: 161-169.
(58) Umrikhina, G. S., 1984. – *Zhivotnyi mir Chuiskoi doliny*. Frunze, Ilim: 1-250.
(59) Ushakov, V. A. & Beloborodova, I. Y., 1989. – Influence of the urbanisation on population characters of *Rana temporaria*. *In*: *Nazemnye i vodnye ekosystemy*, Gorky: 60-66.
(60) Ushakov, V. A. & Pisarenko, S. S., 1989. – Influence of the regulation of river flow on the amphibians. *In*: *Problems of herpetology*, Kiev, Naukova Dumka: 262-263.
(61) Vershinin, V. L., 1987. – Adaptive peculiarities of *Rana arvalis* groups in the conditions of a large city. *Ekologiya*, **1** (1): 46-50.
(62) Yakovlev, V. A., 1990. – On the ecology of *Rana ridibunda* on Altai. *Ekologiya*, **1** (1): 67-71.
(63) Zabroda, S. N., 1988. – Influence of the drying measures on the batrachofauna of Ukrainian Polesje. *In*: *Ratsionalnoe ispolzovanie, okhrana, vosproizvodstvo biologischeskikh resursov i ekologiya vospitaniya*, Zaporozhie: 215.
(64) Zolotarenko, G. S., 1985. – On the record of *Bufo viridis* in the Novosibirsk surroundings. *In*: *Problems of herpetology*, Leningrad, Nauka: 80-81.

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